

(21) Application No 8406287

(22) Date of filing 9 Mar 1984

(30) Priority data

(31) 3308546

(32) 10 Mar 1983

(33) DE

(51) INT CL³
B60T 8/10

(52) Domestic classification
F2F BL GH

(56) Documents cited
GBA 2117850 GBA 2098293 GBA 2057080 GBA 2049852
GBA 2046385 GB 1588909 GB 1476229

(58) Field of search
F2F

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(54) Two-circuit brake system

(57) A two-circuit brake system for motor vehicles, having a two-circuit driver's brake valve 24 and brake cylinders 34 to 37 which can be supplied from the said brake valve 24 by way of two brake circuits, and a common pressure control valve assembly 1 which is equipped with three pairs of valves 7, 8; 9, 10; 11, 12 and which is part of an anti-skid system which comprises wheel sensors, an electronic switching device and a solenoid pilot control valves eg 25 (Fig. 2) for each pair of valves is characterised in that the pressure-control valve assembly is of two-circuit design.

Actuation of the pilot control valve 25 pressurises chamber 20 to separate further the diaphragm assemblies 15', 16' thereby lifting the valve elements 15, 16 from their adjacent seats which close the vent passages 43, 44 of Fig. 2 onto their remote seats to cut off the supply lines 40, 41. Pressurisation of the chambers 19 and 21 seat the valve elements 13, 14 and 17, 18 to retain the instant pressures in the actuators 35 to 37.

FIG. 1

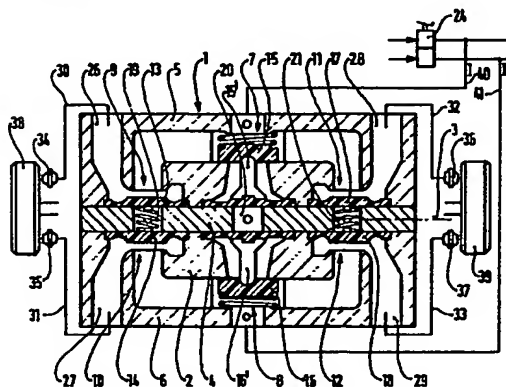
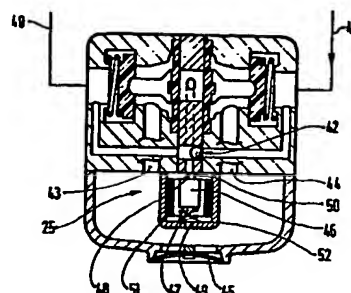


FIG. 2



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FIG. 1

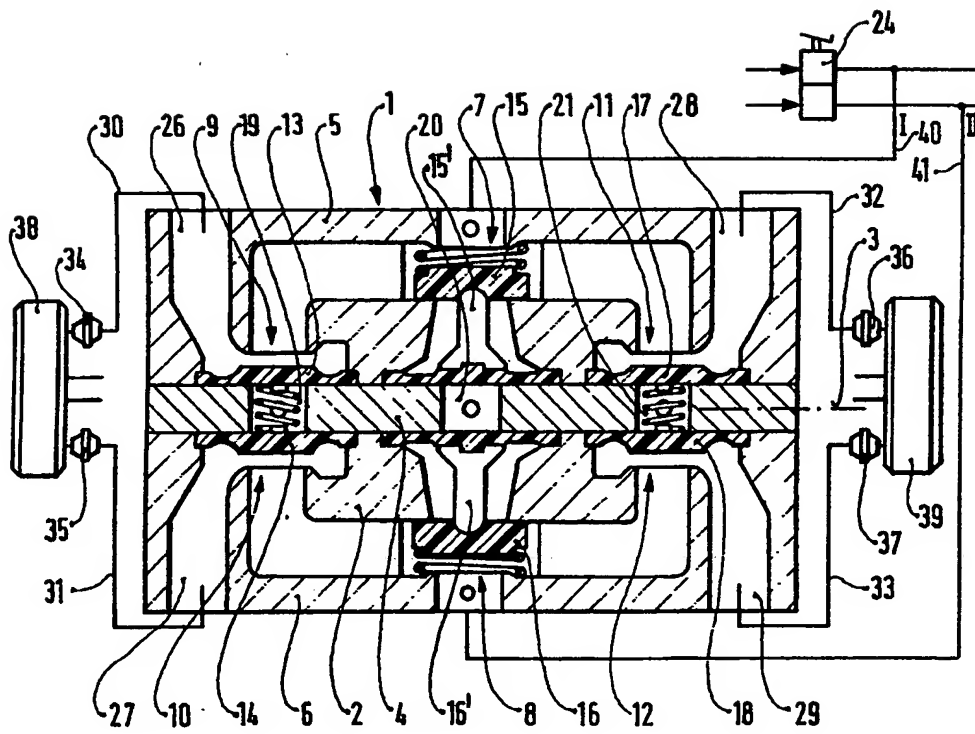


FIG. 2

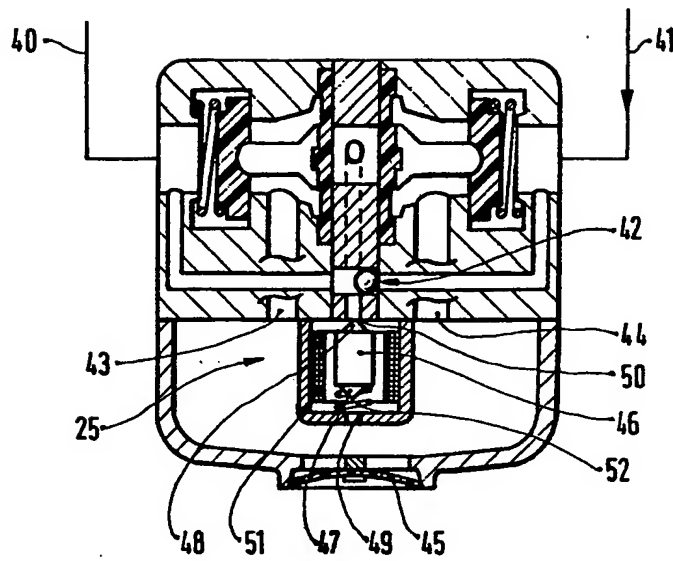
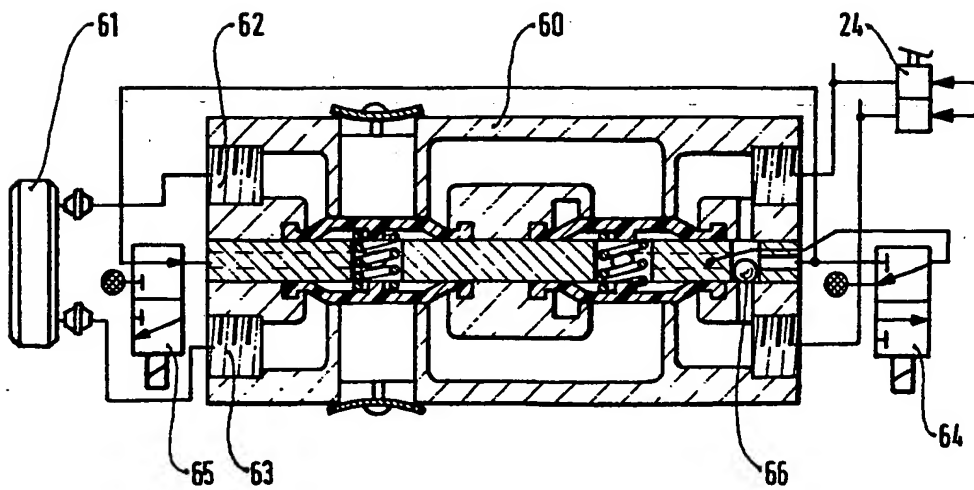


FIG. 3



SPECIFICATION

Two-circuit brake system

5 The invention relates to a two-circuit brake system for motor vehicles, having a two-circuit brake valve and brake cylinders which can be supplied by the said brake valve by way of two brake circuits, and a pressure control valve which is equipped with main valves and which is part of an anti-skid system comprising wheel sensors, an electronic switching device and solenoid pilot control valves.

10 A brake system of this kind is known (German Offenlegungsschrift No. 26 25 502). In this known system, a pressure-control valve is used which is controllable by a brake valve through a single circuit (per axle). If it is desired to use a single-circuit pressure-control valve of this kind in brake systems which act upon one axle or wheel through two circuits, the cost of the anti-skid brake system is almost doubled.

Thus, for example, two pressure-control valves have to be fitted to one vehicle wheel for the two brake circuits and are actuated in parallel by the electronic switching device. In addition to doubling the cost of the valves, the electronic switching device also has to be specially constructed so that it can monitor the function of the pressure-control valves in parallel in addition to undertaking the parallel control thereof.

30 In contrast to this, a pressure-control valve of two-circuit design has the advantage that the cost of individual parts is substantially reduced. In addition to this it has been found that a special electronic switching device does not have to be used, and a normal standard electronic system can be used, such as is normally used in the case of single-circuit pressure-control valves.

35 In accordance with the invention there is provided a two-circuit brake system for motor vehicles, having a two-circuit brake valve and brake cylinders which can be supplied by the said brake valve by way of two brake circuits, and a pressure control valve which is equipped with main valves and which is part of an anti-skid system which comprises wheel sensors, an electronic switching device and solenoid pilot control valves, characterised in that the pressure-control valve is of two-circuit design.

Preferably the two-circuit pressure control valve is single circuit controllable. The pairs of main valves in the pressure control valve preferably are disposed such that their control chambers form a common volume chamber.

Preferably a two-way valve is provided in the anti-skid system which is chargeable by both brake circuits of the brake system and which selects the pressure for the solenoid pilot-control valves of the anti-skid system.

Preferably, the pressure control valve is of symmetrical construction about a central plane, an intermediate plate being disposed in the central plane, which plane incorporates passage for feeding (Transmitting) the pressure made available by the pilot-control valves.

Two two-port two-position valves are preferably disposed at the outlet of the pressure control valve,

the control valve being of two-channel construction. Alternatively, the pressure control valve may be of single-channel construction with one two-port, two-position valve disposed at the outlet thereof.

70 Several embodiments of the invention are illustrated in the drawings and will be further explained in the following description. In the drawings:

Figure 1 shows a two-circuit, two-channel pressure-control valve,

75 Figure 2 shows a two-circuit pilot control valve with pressure selection for single-circuit control, and

Figure 3 shows a two-circuit, single-channel pressure-control valve.

A pressure-control valve 1 has a housing 2 which is constructed symmetrically at both sides of a central axis 3. Namely, two identical housing parts 5 and 6 are located one at each side of an intermediate plate 4 and each housing part has a three-port, two-position valve 7 or 8 respectively and two two-port, two-position valves 9, 11 and 10, 12 respectively. The valves 7 to 12 are main valves. They have valve seats secured relative to the housing and resilient members serving as closure elements whose control parts are diaphragms 13, 14, 15, 16, 17, 18.

90 As a result of the symmetrical arrangement of the housing parts 5 and 6, the diaphragms 13 and 14, 15 and 16, and 17 and 18 are located opposite one another and thereby form respective, common volume chambers 19, 20, 21. Each diaphragm 15 or 16 is a double element having a respective intermediate push rod member 15' or 16'.

The intermediate plate 4 serves on the one hand to centre the control diaphragms 13, 14, 15, 16, 17, 18. This is important for satisfactory transmission of the brake pressures predetermined by a two-circuit service brake valve 24. On the other hand, the intermediate plate 4 has the task of bringing up the control pressures which originate from a pilot control valve 25 illustrated in Figure 2. Three of these pilot control valves 25, that is to say, one for each pair of main valves 7/8, 9/10, 11/12, are disposed in the housing 2 of the pressure-control valve 1. Two pairs of outlets 26, 27 and 28, 29 respectively of the pressure-control valve 1 are connected by way of brake lines 30, 31 and 32, 33 respectively to wheel brake cylinders 34, 35 and 36, 37 respectively, a pair of the said wheel brake cylinders being disposed on a vehicle wheel 38 or 39 respectively. Alternatively, however, each wheel brake cylinder can be a built-in unit in the form of a two-piston cylinder.

Two lines 40 and 41 leading from the two-circuit brake valve 24 are connected to the pilot control valve 25 where there is provided a two-way valve 42 by means of which the higher inlet pressure at any given time can be selected. Figure 2 also shows that each of the two three-port, two-position valves 7 and 8 control a respective atmospheric air passage 43 or 44 which is connected to the atmospheric air by way of a relief valve 45. Only a single pilot control valve 25 is provided for each pair of valves 7/8, 9/10 and 11/12. A pilot control valve 25 of this kind has an armature 46 which carries closure members 47, 48 for two valve seats 49, 50 and which is reciprocable between the valve seats 49, 50 against the force of a spring 52 by means of magnetic forces produced by a coil 51.

The two-circuit brake system which has been described operates in the following manner:

During braking, the two lines 40 and 41 are charged by the two-circuit brake valve 24. The compressed air enters the brake lines 30, 31, 32, 33 by way of the open main valves 7, 8, 9, 10, 11, 12. The brakes are applied by two circuits, that is to say, by two brake cylinders 34, 35 and 36, 37 on each wheel 38 or 39 respectively.

Wheel sensors respond when there is a risk of wheel-lock. The coil 51 of the central pilot control valve 25 is first energized by way of an electronic system, so that the pilot control valve 25 can switch to its other end position. The pressure which is higher at any given time enters the intermediate plate 4 by way of the two-way valve 42 and in the first instances urges the diaphragms 15, 16 and their intermediate push rod members 15' and 16' into their other end positions. The main valves 7 and 8 close. Hence, the inflow of compressed air is prevented. The pressure can then be held pulsed or, together with the pair of main valves 7 and 8, can be discharged by the other two pilot control valves 25 and the four main valves 9, 10, 11, 12.

Hence, it will be seen that the brake pressures flow through two entire circuits and are also two-circuit monitored in the case of anti-skid operation, although, owing to the common volume chambers 19, 20, 21, only a single-circuit pilot control pressure is required. Two-channel pressure regulation is then also possible with the combination of a respective three-port, two-position main valve 7 or 8 with a respective pair of two-port, two-position main valves 9 and 11 or 10 and 12, that is to say, each wheel 38 and 39 has individual regulation.

Hence, an essential prerequisite for an inexpensive, compact type of construction of such a multi-function valve is realised. Since, moreover, the braking capacity of a two-circuit wheel brake does not differ from a single-circuit wheel brake, that is to say, the volume of the two brake cylinders is substantially equal to the volume of the single-cylinder construction, the cross sections of the two-circuit pressure-control valve can also be correspondingly smaller than those of a single-circuit valve. Hence, this also provides the prerequisite for a compact type of construction.

However, the essential advantage results from the single-circuit pilot control valve 25 which renders it possible to combine the initially mentioned category of vehicles (having two-circuit wheel brakes) with a mass-produced standard electronic system designed for single-circuit wheel brakes. Thus it is only in this way that it is possible to realise an inexpensive unit-composed concept which can be applied, with identical structural elements or entire components, to the wide variety of types of commercial vehicles.

It will be appreciated that the safety and reliability of these components are also essential.

This safety and reliability of the proposed two-circuit pressure-control valve 1 resides in the fact that mass-produced individual elements are used, and the centring of the switching elements by way of the intermediate plate 4 also precludes the detrimental effect of differences caused by tolerances.

Even in the event of failure of a brake circuit, the regulating function of the intact circuit is maintained.

The simple, two-way valve 42 which is installed in the

pilot control circuit, and which, as illustrated, can be, for example, a springless ball valve, ensures that the pilot control pressure is taken from the intact brake circuit and that at the same time there is no pressure loss to the defective brake circuit.

In accordance with the construction already described, the type of construction which is illustrated in Figure 3, and which is also symmetrical, shows that it is also possible to construct a pressure-control valve 60 with only one channel (that is to say, to outlets 62 and 63 for one wheel 61). However, this pressure-control valve 60 is also of two-circuit construction. The choice of the pilot control pressure made available by the two pilot-control valves 64 and 65 is effected by way of a two-way valve 66 in the same manner as in the type of construction shown in Figure 2.

Two pressure-control valves 60 of this kind are required for two wheels of a vehicle axle. It will be seen that the cost of valves for one axle is correspondingly higher than that in the type of construction shown in Figures 1 and 2.

CLAIMS

1. A two-circuit brake system for motor vehicles, having a two-circuit brake valve and brake cylinders which can be supplied by the said brake valve by way of two brake circuits, and a pressure control valve which is equipped with main valves and which is part of an anti-skid system which comprises wheel sensors, an electronic switching device and solenoid pilot control valves, characterised in that the pressure-control valve is of two-circuit design.

2. A two-circuit brake system as claimed in claim 1, characterised in that the two-circuit pressure-control valve is single-circuit controllable.

3. A two-circuit brake system as claimed in claim 1 or 2, characterised in that the pressure-control valve has a plurality of main valves disposed in pairs such that the control chambers of each pair of main valves each form a common volume chamber.

4. A two-circuit brake system as claimed in any one of claims 1 to 3, characterised in that a two-way valve is provided which is chargeable by both brake circuits and which selects the pressure for the solenoid pilot control valves of the anti-skid system.

5. A two-circuit brake system as claimed in one of claims 1 to 4, characterised in that the pressure-control valve is of symmetrical construction about a central plane, and that there is disposed in the central plane an intermediate plate which incorporates passages for feeding the pressure made available by the pilot-control valves.

6. A two-circuit brake system as claimed in one of the claims 1 to 5, characterised in that the pressure-control valve is of two-channel construction for the purpose of supplying two different pressures, two two-port two-position valves being disposed at the outlet thereof.

7. A two-circuit brake system as claimed in one of the claims 1 to 5, characterised in that the pressure-control valve is of single-channel construction, one two-port, two-position valve being disposed at the outlet thereof.

8. A two-circuit brake system as claimed in claim 1, substantially as hereinbefore described with reference to and as illustrated in Figs. 1 and 2 of the

accompanying drawings.

9. A two-circuit brake system as claimed in claim 1,
substantially as hereinbefore described with refer-
ence to and as illustrated in Fig. 3 of the accompanying
5 drawings.

Printed in the United Kingdom for Her Majesty's Stationery Office, 8818935,
9/84, 18996. Published at the Patent Office, 25 Southampton Buildings,
London WC2A 1AY, from which copies may be obtained.